A few nails and a yard of wire

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Teaching science in a laboratory without a laboratory - one academic, a cameraman and a demonstrator with a few nails and a yard of wire show how in Mozambique

One of the most pleasant parts of our work is to go to a village where we are going to demonstrate science to children. We work very informally, usually where we are known at least to the children who sometimes turn up and talk to us, sitting on a log under a tree, ask us things and, as likely as not, give us more information than we give them.

We like to arrive with nothing in our hands because we go to demonstrate with local resources, and do not want to import any non-local things except ourselves. And if we come up against a block where we have to have something that absolutely does not exist in the village, it forces us to look for a substitute. That was how we discovered how to use old chicken netting,

Talking with the children we occasionally refer to 'your laboratory' or 'our laboratory', and when the children look puzzled and ask where it is or what we mean, we ask one of them to stand there and extend her arm, point a finger out horizontally and slowly turn around. "There it is," we say.

There is a general complaint in Southern Africa that we have no laboratories, no science apparatus and no chemicals. But our group's speciality is to show that this is the wrong way to look at it. People have become accustomed to see problems and complain, even despair. But there is an alternative - to find opportunities. The more you look, the more you find.

Magnets in the village

"Let's go and buy a battery," we say to the little group of children. They are keen to help because they know they are going to see something interesting. We wander with them to the market - two little stalls, one with vegetables and fruit, and the other with common things like soap, matches, batteries and so on, where we buy a common large-sized torch battery. This turns out to be our only investment for the day.

Then we bargain for a three-inch nail. The stallholder wants to sell us a dozen but we settle for just two. "Go on, take them," he says, "We know you are professors from the university, helping to teach our children."

Well, they are one third right. I am the academic; Mateus is our cameraman and Alberto our demonstrator. We call ourselves the 'Spark Group'.

"Throw in three of those other little nails," we say, and he does.

On the way we back to our tree we pass a piece of rather rusty chicken netting. "Nationalise that," we say, and the children laugh and bring it.

Then comes the main part of our little drama. Two of the children undo some of the chicken netting to get a yard of wire - fiddly work but not difficult - and pull it back and forward to eliminate its wrinkles over an edge of the log we are sitting on. The wire is a bit rusty but that will make no difference to what we are going to do.

They wrap a bit of newspaper round the shank of the nail. That is the insulation. Then wind the wire over the paper, making sure adjacent turns do not touch. Then when the nail is full, another layer of paper and another winding of wire. Then a third layer of paper and wire until the yard of it runs out. Then some sewing thread wound over the end turns so they do not come undone.

Connect the ends of the wire to the battery and... We have an electromagnet that picks up the little nails.

Everybody has a go. "Magic!" they say, delighted.

"No," we say gravely. "Science, Technology."

The next day several children will have made electromagnets at home and some father will complain that his son has nationalised a battery from the family radio and run it down.

Permanent magnets and a magnetic compass

Sometimes common nails are semi-steel and once magnetised will hold a little magnetism. In this case the young experimenters see that one of the little nails stays attracted when the battery is disconnected and understand that the magnetic effect somehow stays in the electromagnet.

We ask the children to make another magnet but with the paper and wire not so tight, so that after magnetising the nail they can pull it out. So they do this and then of course they have a weak permanent magnet.

If the nails are not steel, we ask the children to try to get a piece of old bicycle spoke or an umbrella rib, and bend it backwards and forwards until they have broken a piece off. These are steel and the young people can usually find one or the other in the village. If all else fails, they get a handful of chicken netting and fold, hammer and twist it until they have a tight bundle. This retains magnetism well.

Now they can make a magnetic compass.

They get a thread of fine plastic hair from a girl's plaits, tie it round the middle of the nail, adjust it to hang horizontally, fix it with a bit of chewing gum, and hang it up.

"It will point North and South," we say. But of course it does nothing of the kind. As you can guess, it oscillates interminably and swings in the wind.

So we cut a clear plastic bottle to make a cup, half-fill it with water and hang the nail in the water from a pencil across the top. The water damps the movement of the nail and it comes to rest North-South - a real working compass.

The children of course know where the sun rises and sets so they know roughly where north is, and they take the nail out of the water, fix bits of paper marked 'N' and 'S', on it with chewing gum, re-balance it, and put it back.

More classic physics

Then they make another weak permanent magnet so that with this and the compass needle we can do the classic experiments of north attracting south, repelling another north, seeing if the effect will go through paper or a person's hand, and so on.

"Aha, yes!" they say - that exclamation every teacher likes because it is the arrival of insight - "We learnt about this in the book but we never understood it."

Well, now they will never forget it. In its small way it is dramatic, as all science lessons should be.

They try other things. Will the magnet attract a coin? Yes, our Meticais are cupro-nickel. Of course the weak magnet is far from being able to pick one up but the children can detect the effect by seeing that the end of their compass needle attracts itself to the coin, held near outside the plastic. One of my brass Yale keys? No. The cut-off top of a Coke tin? No, it is aluminium. The sides of the can? Yes, they are iron. And so on and so on. In the end, you can tell that some of the children feel themselves to be real little scientists.

In a primary school, a laboratory is no more needed to teach appropriate science than a language laboratory is needed in a home to teach a baby to talk.

How little we do

Notice that we visitors have done almost nothing physically in these demonstrations; the children have done it all. But we have transmitted some knowledge and confidence to a dozen of the younger generation through our encouragement. Encouragement makes children blossom.

A dozen is not many, but we have a potentially powerful technique to multiply the effect. Later Alberto, Mateus and I will come back with the video camera and the children will do the experiments again and explain in their own way as they do them. Such activities

make rather marvellous films. We have our own video equipment and editing table, so the films are cheap to make, and we hope teacher-training centres will use them.

With similar local resource methods, we can demonstrate a great deal of curriculum material from primary to second year university physics and technology, though at the higher levels we use materials available in towns, much of it from rubbish piles on the street corners. Mozambique is especially good on street garbage. We buy some stuff from street stalls and very occasionally from shops - for example certain tools for higher level work. But our main principle is that in general the things must be extremely accessible to lots of children and teachers.

Chicken netting is just one of our many examples. A better one would have been our solar cooking demonstrations. Villages do not need magnets but they do need solar cookers. However, we find that it does not matter where we start. Once young people find they can do practical, fascinating things, they will take an interest in almost anything. In fact we started these activities many years ago with music, but that is another story.

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